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ABSTRACT

This special bibliography on research in earth science education from the ERIC Center for Science, Mathematics, and Environmental Education provides a list of books which will be useful for educators interested in the field. The period covered in this publication is through the end of 1971. Annotations are given for each item. The sources covered in the publication are doctoral dissertations, educational journals, and the materials in the Educational Resources Information Center (ERIC) System. The bibliography is arranged in five parts: elementary, secondary, college, qualifications of secondary school earth science teachers, and museums and planetariums as educational institutions. (PS)

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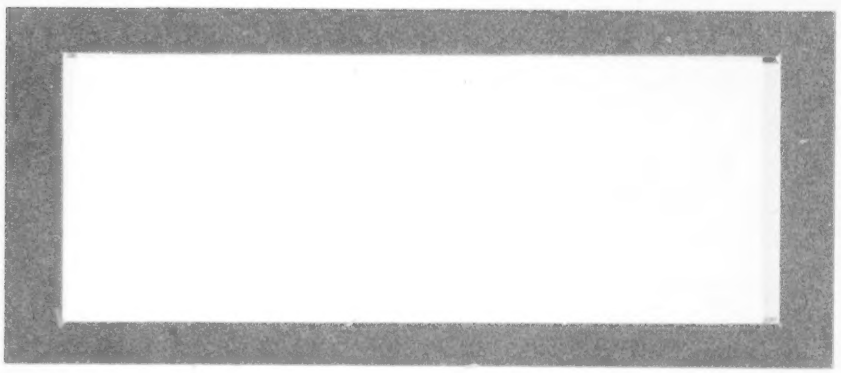

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SCIENCE EDUCATION INFORMATION
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SPECIAL BIBLIOGRAPHIES

BIBLIOGRAPHY 6

RESEARCH IN EARTH SCIENCE EDUCATION:

AN ANNOTATED BIBLIOGRAPHY

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September, 1972

SCIENCE, MATHEMATICS, AND ENVIRONMENTAL EDUCATION INFORMATION REPORTS

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Special Bibliographies are being developed to announce availability of documents in selected interest areas. These bibliographies indicate documents considered to be useful to teachers, curriculum development personnel, and research personnel. They are aimed primarily, however, at teachers and curriculum personnel.

The bibliographies are developed in areas of demand as indicated by communications received at the ERIC Center for Science, Mathematics, and Environmental Education. We invite your suggestions for areas to be included in this series.

Stanley L. Helgeson
Editor

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TABLE OF CONTENTS

EARTH SCIENCE IN THE ELEMENTARY SCHOOL 2

Curriculum content 2

Methods and techniques 7

EARTH SCIENCE IN THE SECONDARY SCHOOL 11

Status of earth science teaching 11

Course content and effectiveness 14

The secondary school classroom environment 19

Student characteristics 26

EARTH SCIENCE IN THE COLLEGES 28

Earth science teacher preparation 28

Methods of teaching science content 31

Student characteristics 36

Science course and program content 37

QUALIFICATIONS OF EARTH SCIENCE TEACHERS 41

MUSEUMS AND PLANETARIUMS 42

RESEARCH IN EARTH SCIENCE EDUCATION:

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This bibliography is intended primarily for the use of researchers in the field of science education. It provides a comprehensive overview of educational research studies associated with the content area of earth science, which were completed and published through the end of 1971. In compiling the bibliography the following types of sources have been reviewed: Doctoral dissertations, educational journals, and the Educational Resources Information Center (ERIC) system. Only research studies readily accessible through normal communication sources have been included.

For convenience, the bibliography has been divided into five major sections. Three are based on the school level on which the research project focused; elementary (grades K through 6), secondary (grades 7 through 12) and college. The fourth category includes studies concerned with the qualifications of secondary school earth science teachers. The last category includes studies focusing on museums and planetariums as educational institutions.

EARTH SCIENCE IN THE ELEMENTARY SCHOOL

Studies focusing on the elementary school level fall into two groups; those concerned with the content of the elementary science curriculum and those concerned primarily with methods and techniques of presenting earth science topics to elementary school children.

Curriculum content

There are 25 studies in this group. They deal with the evaluation of concepts appropriate at the various grade levels, assessment of childrens' ability to understand particular groups of concepts, and the provision of materials to be used by teachers in developing earth science content for the elementary school science curriculum.

Ashbaugh, Alexander C. "An Experimental Study for the Selection of Geological Concepts for Intermediate Grades." Unpublished doctoral dissertation. University of Georgia. 1964. (Dissertation Abstracts 25:10:5775-6. 1965. Order number 65-4483).

See also: Ashbaugh, A. C. "Selection of Geological Concepts for Intermediate Grades." Science Education, 52:2:189-196. March, 1968.

Selected geological concepts were tested and arranged in order of increasing difficulty for fourth, fifth and sixth grade students.

Arnold, Herbert J. "The Selection, Organization, and Evaluation of Localities Available for Unspecialized Field Work in Earth Science in the New York City Region." Unpublished doctoral dissertation. Teachers College. 1936.

A technique for selecting the localities and materials suitable for illustrating selected geological generalizations was developed. Source materials and elementary school study units were prepared.

Atkin, J. Myron "Teaching Concepts of Modern Astronomy to Elementary School Children." Science Education, 45:1:54-58. February, 1961.

High IQ 4th, 5th, and 6th grade students studying basic modern astronomy topics had high interest and were able to comprehend many significant astronomy topics.

Brown, Daniel H. "Knowledge of Important Principles of Physical Geography Possessed by Selected Sixth-Grade Children." Unpublished doctoral dissertation. University of Kansas. 1963. (Dissertation Abstracts 24:1:5072-3. 1964. Order number 64-6804).

This study identified 35 physical geography principles deemed suitable for inclusion in the elementary school curriculum.

Brusini, Joseph Anthony "An Experimental Study of the Development of Science Continua Concepts in Upper Elementary and Junior High School Children." Unpublished doctoral dissertation. Northwestern University 1966. (Dissertation Abstracts 27:7:2094-5A. 1967. Order number 66-13,961).

The formation of a concept requiring the recognition of a continuum (the cycle of stream erosion) is more closely related to the amount of direction received than to student age. Low relationships were found between concept formation ability and both age and intelligence.

Caruso, Mary L. "An Ocean Geography for Children." Unpublished doctoral dissertation. Teachers College, Columbia University. 1957.

Oceanographic concepts appropriate for elementary school instruction were identified and a resource unit developed to aid teachers having a limited knowledge of oceanography.

Davies, Gordon F. "Map Skills and Understandings in Intermediate School Social Studies." Unpublished doctoral dissertation. Stanford University. 1962. (Dissertation Abstracts 23:3:948-9. 1962. Order number 62-4032).

Ten skill and understandings areas were identified and subsequent activities for each area were developed.

Davis, Ozro L., Jr. "Learning About Time Zones: An Experiment in the Development of Certain Time and Space Concepts." Unpublished doctoral dissertation. George Peabody College for Teachers. 1958. (Dissertation Abstracts 19:11:2861-2. 1959. Order number 59-1093).

Gains in student understandings of geographic time zones occurred at each grade level (4, 5, 6).

Erickson, Jay William "The Earth in Space: A Source Book for the Modern Elementary School Science Program of the Science Manpower Project." Unpublished doctoral dissertation. Columbia University. 1963. (Dissertation Abstracts 29:1:58A. 1968. Order number 66-6546).

This sourcebook of content and suggestions for teaching the astronomy and oceanography areas is designed for use by elementary school teachers, science consultants, curriculum designers, and others involved in the teaching of science to children.

Haupt, George W. "First-Grade Concepts of The Moon." Science Education, Part I,32:258-262. October, 1948. Part II,34:224-234. October, 1950.

Interview and classroom observation techniques were employed to identify and classify concepts of the moon held by first grade students.

Hunt, Ronald L. "The Effects of the San Diego Community Educational Resources Project on the Teaching of Elementary Space Science." Unpublished doctoral dissertation. University of California, Los Angeles. 1964. (Dissertation Abstracts 25:3:1683. 1964. Order number 64-9632).

The project's sequence of curriculum development, preparation of materials, and preparation of instruction in space science was studied to determine whether it had accomplished its goal of reducing the time lag between the discovery of new scientific knowledge and its availability. Student results indicated that significantly greater gains in space science achievement were made by 5th and 6th grade students whose teachers received training and used materials prepared by the project than by students whose teachers did not.

Janke, Delmar Lester "The Concept Currency of K-12 Science Textbooks Relative to Earth Science Concepts." Unpublished doctoral dissertation. University of Wisconsin. 1969. (Dissertation Abstracts 31:1:653A. 1970. Order number 70-3568).

This study compared the 52 concepts agreed upon by three panels of earth scientists as those which should be included in a K-12 science curriculum to those concepts presented by a random sample of K-12 science textbooks. The results indicated that the majority of the concepts were presented in the texts studied and that they thus probably occurred in the curriculum.

Johnson, Mervin L. "A Determination of Aerospace Principles Desirable for Inclusion in Fifth or Sixth Grade Science Programs." Unpublished doctoral dissertation. Colorado State College. 1966. (Dissertation Abstracts Part I, 27:12:4042-3A. 1967. Order number 67-6077).

This study determined the aerospace principles and the extent to which they were included in current textbooks. Current elementary textbooks were found to be not suitable as resource materials in this area, and a multi-text approach was recommended.

Joyce, William W. "The Development and Grade Placement of Map and Globe Skills in the Elementary Social Studies Program." Unpublished doctoral dissertation. Northwestern University. 1964. (Dissertation Abstracts 25:11:6434-5. 1965. Order number 65-3279).

Grade placement of map and globe skills was established.

King, Robert Nephew "The Earth On Which We Live: A Sourcebook for the Modern Elementary School Science Program of The Science Manpower Project." Unpublished doctoral dissertation. Columbia University. 1964. (Dissertation Abstracts 26:4:1993. 1965. Order number 65-2281).

A source book of basic and recent earth science information appropriate for elementary school teachers was developed. It suggests a sequence of experiments, demonstrations, projects and other teaching procedures useful in helping children perfect their understanding of earth science principles and generalizations.

Klopfer, Leopold E. "Effectiveness and Effects of ESSP Astronomy Materials--An Illustrative Study of Evaluation in a Curriculum Development Project." Journal of Research in Science Teaching, 6:1:64-75. 1969.

Fifth grade students who studied the Elementary School Science Project material were moderately successful in mastering some of the topics that were taught. They also gained knowledge about certain astronomical topics that were not specifically taught.

Kuse, Hildegard Rosa "A Survey of the Sources and Extent of Primary Grade Children's Concepts of Elementary Astronomy." Unpublished doctoral dissertation. University of Colorado. 1963. (Dissertation Abstracts 26:3:1513-14. 1965. Order number 64-4361).

This study of the background knowledge of first, second and third graders concerning space and their sources of information indicated: 1) little agreement among textbook writers as to what concepts about astronomy should be taught, 2) certain aspects of astronomy were beyond the knowledge of most primary grade children, 3) descriptions of appearance of objects were more common than explanations of causes of phenomena, and 4) children relied on a wide variety of sources for their information about astronomy or space exploration.

Portugaly, Drora "A Study of the Development of Disadvantaged Kindergarten Children's Understanding of the Earth as a Globe." Unpublished doctoral dissertation. Columbia University. 1967. (Dissertation Abstracts 28:10:4056A. 1968. Order number 68-5544).

Students developed basic concepts of the earth and were able to manipulate models illustrating the concepts.

Rabozzi, Mario D. "Extent of Certain Geographical Skills of Latitude and Longitude of Selected Fifth and Sixth Grade Children." Unpublished doctoral dissertation. Pennsylvania State University. 1961. (Dissertation Abstracts 23:5:1630. 1962. Order number 62-2644).

Fifth and sixth grade students were able to use longitude and latitude for locational purposes.

Schumacher, Vernon A. "Fifth and Sixth Grade Students' Understanding of Surface Features of The Earth." Unpublished doctoral dissertation. Iowa State University. 1961. (Dissertation Abstracts 22:8:2639. 1962. Order number 61-5606).

The difficulty students had in understanding terms related to surface feature was determined.

Shadoin, Bernard "Adapting Technical Scientific Data for Use in Elementary School Earth Science (Parts I and II)." Unpublished doctoral dissertation. The University of Arkansas. 1966. (Dissertation Abstracts 26:8:4511-12. 1966. Order number 65-13,115).

A search of the technical geological literature, and a survey of science educational personnel were used to determine types of resource information available appropriate to elementary school instruction. A procedure for teachers to follow in adapting the technical information to use in the elementary earth science class was developed and followed to prepare earth science information for use in the Northwest Arkansas area.

Sheridan, Jack M. "An Investigation of Beginning First Grade Children's Awareness Regarding a Selected Number of Concepts of Physical Geography." Unpublished doctoral dissertation. University of Oregon. 1964. (Dissertation Abstracts 25:10:5649-50. 1965. Order number 65-2482).

See also: Sheridan, Jack M. "Children's Awareness of Physical Geography." Journal of Geography, 67:82-86. February, 1968.

First grade children were found to have some awareness of most of the concepts investigated. Their greatest source for awareness was direct contact, television, and parents.

Sorohan, Lawrence J. "The Grade Placement of Map Skills According to the Mental Ages of Elementary School Children." Unpublished doctoral dissertation. Ohio University. 1962. (Dissertation Abstracts 23:7:2452. 1963. Order number 63-1066).

The most effective grade placement in grades 4-6 was determined for selected map skills.

Weinswig, S. Edward "Evaluation of Lessons to Teach Introductory Map Skills in Grade Four." Unpublished doctoral dissertation. Boston University. 1962. (Dissertation Abstracts 23:4:1295. 1962. Order number 62-4805).

Lessons developed were effective in teaching map skills to children working alone, in pairs or in teams of three.

Yuckenberg, Laura M. "Children's Understanding of Certain Concepts of Astronomy in the First Grade." Science Education, 46:2:148-150. March, 1962.

Astronomical concepts held by first grade children included many held by adults, therefore, the study of astronomy at an early age was considered feasible. Experiences in astronomy concept learning were deemed to enhance further achievement of astronomy concepts.

Methods and techniques

This group of 15 studies focuses primarily upon the relative effectiveness of different techniques and methods in the presentation and learning of earth science content by elementary school children.

Belgum, Loretta E. "An Investigation of the Effect of Teaching Interpretation of Geographic Photographs to Sixth Graders." Unpublished doctoral dissertation. University of California, Berkeley. 1967. (Dissertation Abstracts 28:1:137A. 1967. Order number 68-10,259).

Skills of identifying and interpretating landscape features from photographs can be significantly increased through instruction. Intelligence, but not sex, was significantly related to photographic interpretation ability.

Bennett, Lloyd M., and Clodfelter, Cherie "A Study of the Integration of an Earth Science Unit Within the Reading Program of a Second Grade by Utilizing the Word Analysis Approach." School Science and Mathematics, 66:8:729-736. November, 1966.

The word analysis approach was found to be effective in teaching selected earth science topics to second grade students.

Carmichael, Dennis R. "Developing Map Reading Skills and Geographic Understandings by Means of Conceptual Teaching Methods." Unpublished doctoral dissertation. University of California, Berkeley. 1965. (Dissertation Abstracts 26:12:I:7176. 1966. Order number 66-3529).

The inquiry-discovery approach increased map-reading skills, geographic understandings, self-directed learning, and motivation and interest when used with elementary students.

Cohen, Michael Robert "The Effect of Natural Small Scale Geologic Features on the Concepts of Fluvial Geology Among Fifth and Sixth Grade Children." Unpublished doctoral dissertation. Cornell University. 1968. (Dissertation Abstracts 29:12:I:4369 1969. Order number 69-7375).

This was a study of the effect of using activities concerning small scale geologic features to develop concepts of erosion, deposition, and lakes. Results indicated that their use may not be effective at these grade levels.

DeRoche, Edward F. "A Study of the Effectiveness of Selected Creative Exercises on Creative Thinking and The Mastery of a Unit in Elementary Science." Unpublished doctoral dissertation. University of Connecticut. 1966. (Dissertation Abstracts 27:12:I:4162-3A. 1967. Order number 67-4542).

The effectiveness of using creative exercises and traditional exercises in space science upon achievement and creative thinking of sixth graders was evaluated. Relationships between intelligence, space science achievement, and creative thinking of sixth grade students were found.

Eaton, Edward Jefferson, Jr. "An Investigation of the Relationship of Three Factors in Printed Materials to Achievement in Astronomy by Sixth Grade Students." Unpublished doctoral dissertation. University of Illinois. 1964. (Dissertation Abstracts 25:11:6429. 1965. Order number 65-3572).

Identified were the roles of three specific factors found in printed instructional materials which affected the level of pupil achievement; number of questions, activities, and incongruities. The manner in which materials were written made a significant difference in the learning which took place.

Fanning, Robert J. "A Study of the Efficiency of Programmed Instruction Under Two Conditions of Use." Unpublished doctoral dissertation. St. John's University. 1969. (Dissertation Abstracts 31:6:2788-9A. 1970. Order number 70-22,252).

The use of programmed material supplemented by teacher-directed activities was superior to the use of only the programmed textbook in teaching latitude and longitude to fifth grade students.

Korey, Ruth Ann "Contributions of Planetariums to Elementary Education." Unpublished doctoral dissertation. Fordham University. 1963. (Dissertation Abstracts 25:4:2379-80. 1964. Order number 64-2429).

A survey of directors of planetariums and museums indicated that the most frequent planetarium service for elementary schools was the organized visit and that nearly all sky shows for elementary school classes were descriptive in nature. From 1930 to 1962 the number of planetariums in the United States increased from one to approximately two hundred. At the time of the survey, additional planetariums were under construction, planned, or desired in many communities.

Litvack, Howard "A Study of the Effect of Two Different Methods of Classroom Evaluation on Achievement in Science Content." Unpublished doctoral dissertation. Temple University. 1970. (Dissertation Abstracts 32:3:1192-3A. 1971. Order number 71-10,825).

The relative effects of teacher evaluation and pupil self-evaluation upon fourth and fifth grade students' achievement in earth and space science, physics and biology topics are reported.

Roos, Anne D. "A Content Analysis of Published and Original Verse Suitable for Primary Grade Science." Unpublished doctoral dissertation. Temple University. 1967. (Dissertation Abstracts 28:12:I:4831-2A. 1968. Order number 68-9032).

Most verses judged suitable for use in primary grade science programs concerned "Living Things" and "The Earth".

Rosemergy, John C. "An Experimental Study of the Effectiveness of a Planetarium in Teaching Selected Astronomical Phenomena to Sixth Grade Children." Unpublished doctoral dissertation. University of Michigan. 1968. (Dissertation Abstracts 28:12:I:4959-60A. 1968. Order number 68-7709).

In comparing the effectiveness of planetarium and conventional teaching methods, no significant differences occurred in achievement of understanding of lunar phases and apparent turning of the sky.

Shrigley, Robert L. "Handmade Versus Commercial Equipment in Elementary School Science." Unpublished doctoral dissertation. Pennsylvania State University. 1968. (Dissertation Abstracts 29:12:I:4203A. 1968. Order number 69-9807).

See also: Shrigley, Robert L. "Handmade Versus Commercial Equipment in Elementary School Science." Science Education, 55:3:361-369. July-September, 1971.

Sixth grade students taught weather and astronomy topics with the aid of commercial equipment achieved significantly higher on recall items than did those students taught with handmade equipment.

Skinner, Ray, Jr. "An Experimental Study of the Effects of Different Combinations of Television Presentations and Classroom Teacher Follow-up on the Achievement and Interest in Science of Fifth Graders." Unpublished doctoral dissertation. Kent State University. 1966. (Dissertation Abstracts 28:2:551-2A. 1967. Order number 67-9429).

See also: Skinner, Ray, Jr. "Inquiry Sessions: An Assist for Teaching Science via Instructional Television in the Elementary Schools." Journal of Research in Science Teaching, 5:4:346-350. December, 1968.

Presenting geological topics through four combinations of television lessons and teacher follow-ups was explored.

Smith, Billy Arthur "An Experimental Comparison of Two Techniques (Planetarium Lecture-Demonstration) of Teaching Selected Astronomical Concepts to Sixth Grade Students." Unpublished doctoral dissertation. Arizona State University. 1966. (Dissertation Abstracts 27:4:887A. 1966. Order number 66-6906).

Sixth grade students experiencing a classroom lecture-demonstration method of presentation achieved significantly higher than those experiencing a planetarium lecture-demonstration on a teacher constructed objective test of astronomical concepts.

Uslan, David T. "A Study of Geographic and Related Physical Science Concepts and Understandings Attainable Through the Media of School Radio Communication." Unpublished doctoral dissertation. University of California, Los Angeles. 1964. (Dissertation Abstracts 25:10:5800-1. 1965. Order number 65-3960).

An investigation to assess the attainability of concepts and understandings by fifth graders using short-wave radio communication, found that the group using the radio showed significantly higher achievement and understanding of the concepts than did the control group.

EARTH SCIENCE IN THE SECONDARY SCHOOL CURRICULUM

The largest number of studies is that concerned with the secondary level. These were separated into four groups; those assessing the status of earth science teaching at either the state or national level; those focusing on the content included in the earth science or general science curriculum; those focusing on the nature and types of instruction used in the classroom; and a fourth group pertaining to student characteristics.

Status of earth science teaching

Seventeen studies attempted to assess the status of earth science teaching at either the state or national level. They generally were concerned with the number of students enrolled in earth science, the number of earth science teachers, and the nature of the courses taught.

Baker, Vernon R. "The Status of Earth Science Education in Arkansas." Unpublished doctoral dissertation. University of Arkansas. 1967. (Dissertation Abstracts 28:1:137A. 1967. Order number 67-8704).

Questionnaires directed to the administrators of colleges and universities provided information on the status of earth science in the secondary schools and on programs of earth science teacher preparation in colleges and universities.

Coash, John R. "Earth Science in Secondary Schools." Geotimes, 7:6:26-29. March, 1963.

This survey of state supervisors revealed that earth science courses at the secondary level were offered or would be offered soon in 39 states.

Cranson, K. R. "Earth Science in Michigan Secondary Schools 1968-1969." School Science and Mathematics, 71:2:134-138. February, 1971.

A questionnaire survey of secondary schools determined the number offering earth science courses, enrollment by grade level, and the most frequently used textbooks.

Geyer, Alan R., and Shirk, William R. "Pennsylvania's Secondary School Earth Science Course - Ten Years of Progress." Journal of Geological Education, 18:3:118-121. May, 1970.

This study determined the status of earth science in Pennsylvania's secondary schools; identified problem areas in the curriculum offerings; and determined the educational backgrounds of Pennsylvania secondary school earth science teachers.

Grobman, Sydney "Status Study of Schools Teaching Earth and Space Science in Pennsylvania, 1965-66." Pennsylvania Department of Public Instruction. January, 1966. 24 pp.
ED 018 358 MF $0.65 HC $3.28

Earth-space science in secondary schools was found to be a relatively new curriculum (less than 5 years in most cases), and had small enrollment. Courses used The World We Live In by Namowitz and Stone (Van Nostrand Company Inc.) as a text, and were laboratory oriented.

Hume, James D. "Earth Science in the New England Public Secondary Schools." Journal of Geological Education, 12:4:138-140. December, 1964.

A report of the rapid growth of earth science offerings in New England secondary schools.

Kendall, David L. "Earth Science In Connecticut Secondary Schools." Journal of Geological Education, 16:5:178-180. December, 1968.

The history of earth science in Connecticut secondary schools is related. Also reported are the characteristics of the programs taught in the schools and the requirements of earth science majors preparing to become teachers at the State Colleges of Connecticut.

Kosoloski, John E. "The Pennsylvania Earth and Space Science Program." Geotimes, 7:3:15-17. 1962.

A report of the growth of the earth-space science program in Pennsylvania secondary schools.

Laux, Dean M. "Earth Science Courses in New Jersey and the Qualifications of Teachers." Geotimes, 3:3:17-19. 1962.

The results of a survey of New Jersey Schools and earth science teachers is reported.

Mayer, Frederick R. "The Pennsylvania Department of Public Instruction's Earth and Space Science Curriculum Promotional Program and the Status of Earth and Space Science Education in the Public Secondary Schools of Pennsylvania, 1963-64." Unpublished doctoral dissertation. Temple University. 1965. (Dissertation Abstracts 26:8:4386-7. 1966. Order number 66-661).

This survey of 205 school districts in Pennsylvania found that science teachers were generally instrumental in the promotion of an earth-space curriculum in their schools. The course content was based either on current textbooks or the state's earth science teaching guide and was rarely teacher developed.

Qutub, Musa Y. "The Status of Earth Science in Illinois." Journal of Geological Education, 18:4:163-165. September, 1970.

A survey of colleges and earth science teachers indicated the grade levels at which earth science was being offered and the academic preparation of earth science teachers.

Reith, Howard C. "A Study of Selected Earth Science Teachers in North Dakota for the Academic Year 1968-1969." Unpublished doctoral dissertation. University of North Dakota. 1969. (Dissertation Abstracts 31:1:254B. 1971. Order number 70-11,409).

The development of earth science courses in North Dakota is traced. Recommendations for the improvement of earth science programs are made based on a survey of state departments of education and literature.

Roth, Robert A. "Earth Science and Ohio." Journal of Geological Education, 17:5:185-187. December, 1969.

A rapid increase of earth science offerings in Ohio secondary schools and of programs offered for prospective earth science teachers in Ohio colleges and universities is reported.

Skinner, Ray, Jr., and O. L. Davis, Jr. "Preparation of Earth Science Teachers in Ohio." Journal of Geological Education, 13:3:85-87. June, 1965.

A survey of Ohio high schools and earth science teachers in 1963 indicated that earth science was offered at three levels in the schools: to ninth graders, to lower ability 10th-12th graders and to high ability 12th graders. The courses were generally laboratory in nature and frequently involved several field trips. Ohio teachers were found to have good earth science teaching qualifications.

Stone, Donald B. "Growth of Earth Science in New York State." Geotimes, 7:3:13-15. 1962.

The history and growth of New York State earth science curriculum offerings (1948-1962) is reported.

Shappell, Dean L. and Mayer, Victor J. "The Growth of Earth Science." The Ohio School Boards Journal, 12:8:8-10. August, 1968.

The growth of enrollment and course offerings in earth science in Ohio schools is traced. Its status in 1967 is described, based upon information from the annual Principal's Reports of the State Department of Education.

Wall, Charles A. and Qutub, Musa Y. "Earth Science in Wisconsin." Illinois Earth Science Association Newsletter, 1:1:10-12. September, 1971.

Information on student enrollment, preparation of teachers and teaching methods used in secondary school earth science was obtained from a survey of teachers conducted during the 1970-71 school year.

Course content and effectiveness

There are 19 studies focusing primarily on the earth science content of the secondary school science curriculum. Included are studies determining appropriate earth science content for earth science and general science courses and studies evaluating the effectiveness of curricula such as the Earth Science Curriculum Project.

Batten, James W. "An Investigation and Analysis of Laboratory Experiences in Earth Science." Unpublished doctoral dissertation. University of North Carolina. 1960. (Dissertation Abstracts 21:7:1867-8. 1961. Order number 60-4826).

The objectives of this study were 1) to determine the extent and nature of earth-science programs in North Carolina high schools and 2) to identify basic earth science concepts and design basic laboratory experiences around these concepts.

Caldwell, Loren Thomas "A Determination of the Earth Science Principles Desirable for Inclusion in the Science Program of General Education in the Secondary School." Unpublished doctoral dissertation. Indiana University. 1953. (Dissertation Abstracts 14:1:47. 1954. Order number 6107).

See also: Caldwell, Loren T. "Determination of Earth Science Principles Desirable for Inclusion in the Science Program of General Education in the Secondary School." Science Education, 39:3:196-213. April, 1955.

This investigation was designed to compile earth science source materials, select and analyze earth science principles. The results included a list of 332 principles of which 296 were judged desirable and 191 highly desirable for inclusion in secondary school science programs.

Chapman, John M. and Caldwell, Loren T. "A Content Study of Earth Science Courses in Selected Secondary Schools." Science Education, 48:5: 430-436. December, 1964.

It was found that little emphasis was placed on the topics of "geologic history of the earth", "chemistry and physics of astronomy", and the "scientific aspects of conservation". At that time recent emphasis was upon oceanography, world climates, and the space science aspects of planetary sciences.

Davison, Hugh M., and Fowler, H. Seymour "Earth Science Course Evaluation: What do They Learn in Earth Science?" Science Education, 49:2:184-185. March, 1965.

Students in earth science courses learned more earth science topics than did those enrolled in general science courses.

Dolezal, Wilma Miriam "A Critical Analysis of Aerospace Education in Texas." Unpublished doctoral dissertation. The University of Texas at Austin. 1968. (Dissertation Abstracts 29:10:3321A. 1969. Order number 69-6136).

Most of the programs in schools and colleges were initiated by a highly interested individual. Student and instructor interest and administrative and civic support have made the programs effective.

Edwards, Seth Jaivant "A Proposed Course in Earth Science for the Secondary Science Curriculum of Indian Schools, Developed from the Analysis, Evaluation, and Adaptions of Earth Science Courses Being Taught in the United States of America." Unpublished doctoral dissertation. Indiana University. 1968. (Dissertation Abstracts 29:4:1162A. 1968. Order number 68-13,684).

The design of an earth science course for India's schools involved analysis and adaptation of the ESCP text and materials.

Engelbrekston, Sune "Industrial Arts: Its Application to Astronomy. The Development of a Resource Unit in Astronomy for the Industrial Arts Curriculum in the Junior High Schools of New York State." Unpublished doctoral dissertation. New York University. 1961. (Dissertation Abstracts 23:2:542-3. 1962. Order number 62-1394).

See also: Englebrekston, Sune "A Resource Unit in Astronomy for the Industrial Arts Curriculum in the Junior High Schools of New York State." The Bulletin of the National Association of Secondary School Principals, 46:241-242. February, 1962.

In a feasibility study of expanding the scopes of science and industrial arts courses, an astronomy resource unit was developed. Suggestions are made for the construction of astronomy projects.

Henson, Kenneth Tyrone "An Identification of Earth Science Principles Pertinent to the Junior High School Programs, and an Analysis of the Eighth Grade Alabama Textbooks in Terms of the Principles Contained Therein." Unpublished doctoral dissertation. Alabama University. 1970. (Dissertation Abstracts 30:11:4682A. 1970. Order number 70-9354).

See also: Henson, Kenneth T. "Earth Science Principles Pertinent to the General Education Programs in Junior High School." Science Education, 54:2:189-195. April-June, 1970.

Henson, Kenneth T. "Representation of Pertinent Principles in Current Science Textbooks." School Science and Mathematics, 70:7:646-648. October, 1970.

This investigation utilized a literature review in identifying earth science principles. The 199 principles were cut to 108 deemed essential by a team of junior high earth science teachers.

Henson, Stanley J. "A Study of the Science Achievement of Earth Science Curriculum Projects From Different Socioeconomic Areas." Unpublished doctoral dissertation. Oklahoma State University. 1970. (Dissertation Abstracts 31:11:5874A. 1971. Order number 71-11,165).

This study compared the science achievement of 9th grade ESCP students from three socioeconomic areas. Significantly greater achievement occurred in the upper socioeconomic group than in either the middle or lower groups. Intelligence was found to be an influencing variable while attitude and science achievement were not.

Krahm, Barbara "Attitudes and Opinions of Principals and Teachers Involved In An Experimental Earth Science Program in New York State." Unpublished doctoral dissertation. Fordham University. 1970. (Dissertation Abstracts 31:7:3218A. 1971. Order number 71-34).

Principals with high commitment and teachers who supported science, appraised student learning and the nature of the program more positively than did educators having low commitment.

Lamie, Richard G. "A Formal Course in Oceanography at the Secondary School Level Through Independent Study, Summary Report and Final Report." National Cash Register Company. 1969. 36 pp.
ED 016 619 MF $0.65 HC $3.28

The feasibility of introducing a course in oceanology at the secondary level was determined. Students on independent study could interrelate the areas of science they studied.

McElroy, Janice H. "Oceanography for the Secondary School: A Curriculum Model Designed from Classroom Experimentation." Unpublished doctoral dissertation. United States International University. 1970. (Dissertation Abstracts 31:5:2206A., 1970. Order number 70-22,334).

The status of oceanographic education and its present trends are reported. A comprehensive curriculum and resource guide is provided.

Moore, Joe Midge "The Course Content of Life, Earth, and Physical Science Programs in Selected Texas Junior High Schools." Unpublished doctoral dissertation. North Texas State University. 1968. (Dissertation Abstracts 29:6:1686A. 1968. Order number 68-16,644).

This study 1) analyzed the current course content in junior high school science, and 2) compared the emphasis of topics reported by junior high school science teachers with the emphasis of topics recommended as optimum by Texas science supervisors and national science education specialists. Results indicated agreement on the level of emphasis to be placed on most life, earth, and physical science topics.

Qutub, Musa Y. "The Objectives of the Earth Science Curriculum Project; An Evaluation of Their Achievement." Unpublished doctoral dissertation. Iowa State University. 1969. (Dissertation Abstracts 30:6:2763B. 1969. Order number 69-20,662).

See also: Qutub, Musa Y., and Hussey, Keith M. "The Earth Science Curriculum Project." Science Activities, 4:5:22-26. January, 1971.

Qutub, Musa Y. "Teaching Earth Science in High School." Science Activities, 4:4:10-14. December, 1970.

Results of the study indicated that teachers surveyed favored the 1967 edition over previous editions and that they did not favor standardized ESCP earth science tests.

An examination of the textbook found that most of the conceptual objectives were developed.

Schroeter, Elizabeth Arlene "Earth Science in the Secondary Schools." Unpublished doctoral dissertation. University of Toronto. 1953.

Earth science concepts and topics suitable for inclusion in secondary school science programs, resource materials available to teachers, and the nature of earth science programs in the secondary schools are identified. A curriculum guide is provided.

Smith, Herbert A. "An Analysis of a Typical Instructional Unit in Junior High School Science to Determine the Explicit and Implicit Concept Loading Involved." U.S. Department of Health, Education, and Welfare. Project #7-8186. June, 1968. 19 pp.
ED 024 574 MF $0.65 HC $3.28

This study was an intensive subjective analysis of an instructional unit; Chapter 26, "The Universe and its Origin" from the preliminary version of the Earth Science Curriculum Project text. The explicit concept load was found to be heavy, but the implicit concept load was much greater and projected a level of sophistication few junior high school students possossed. The material was not particularly well organized.

Therkelsen, Edward R. "The Basic Mathematics of Astronomy: Sourcebook for Science Teachers." Unpublished doctoral dissertation. University of Denver. 1970. (Dissertation Abstracts 31:7:3186A. 1971. Order number 70-26,400).

Topics included were suggested by secondary school teachers.

Voss, Burton E. "Aerospace Concepts of Ninth Grade Students." Science Education, 51:4:391-396. October, 1967.

A list of 72 concepts was developed and evaluated for their level of difficulty.

Wynne, Harold Marlin "A Comparison of 'Time, Space, and Matter', General Science Courses in Eighth and Ninth Grades." Unpublished doctoral dissertation. Lehigh University. 1968. (Dissertation Abstracts 29:11:3820-1A. 1969. Order number 69-7368).

The earth science program was equal to the TSM in science process application and learning of facts of general science. None of the approaches had a significantly greater effect in changing attitudes toward science.

Refer also to the following studies described in the previous section:

Brusini p. 3 Janke p. 4

The secondary school classroom environment

This, the largest single group of studies included 28 that focused on the classroom, and the learning environment created there by the teacher. The studies dealt with teacher-student interaction, teacher characteristics, inquiry and laboratory approaches as compared to traditional approaches, and the evaluation of specific teaching techniques.

Abruscato, Joseph Anthony "The Student Communication (SCAN) System; Its Development and Preliminary Utilization." Unpublished doctoral dissertation. Ohio State University. 1969. (Dissertation Abstracts 30:10:4323A. 1969. Order number 70-6708).

The development of a category system to describe classroom verbal and non-verbal behavior in junior high science was followed by a test study on eight ninth-grade earth science classes. The results show student and teacher behaviors related.

Agne, Russell M. "A Comparison of Earth Science Classes Taught by Using Original Data in a Research-Approach Versus Classes Taught by Conventional Approaches Not Using Such Data." Unpublished doctoral dissertation. University of Connecticut. 1970. (Dissertation Abstracts 31:3:918A. 1970. Order number 70-15,522).

The teaching of meteorology and climatology by the use of original data in a research approach technique resulted in greater student critical thinking performance than did conventional techniques when tried with junior high school classes.

Benz, Grace "An Experimental Evaluation of Field Trips for Achieving Informational Gains in a Unit on Earth Science in Four Ninth Grade Classes." Science Education, 46:1:43-49. February, 1962.

Field trips resulted in higher gains in knowledge of geology and in student interest than did an audio-visual simulated field trip.

Chamberlain, Virginia May "A Description of the Use of a Value Clarification Approach into the Teaching of Earth Science Classes." Unpublished doctoral dissertation. Michigan State University. 1971. (Dissertation Abstracts 32:6:3148A. 1971. Order number 71-31,175).

The use of this approach with secondary school students seemed to result in a greater recognition of the relevance of science, more involvement in local ecological issues, and greater desire for background information on ecological issues.

Erickson, William C. "Analysis of The Inquiry-Oriented Earth Science Curriculum Project and Introductory Physical Science Materials." Unpublished doctoral dissertation. United States International University. 1971. (Dissertation Abstracts 31:6:2788A. 1970. Order number 70-24,419).

Ninth grade students taught with the inquiry-approach achieved slightly higher than did a control group taught with textbook and lecture discussion approaches. Both eighth grade groups had comparable achievement.

Friend, Harold "A Comparison of the Relative Effectiveness of Two Methods of Teaching the Course Time, Space, and Matter to Selected Eighth Grade Pupils." Unpublished doctoral dissertation. New York University. 1968. (Dissertation Abstracts 30:1:204-5A. 1969. Order number 69-11,745).

See also: Friend, Harold "A Comparison of the Relative Effectiveness of Two Methods of Teaching the Course, Time, Space, and Matter to Selected Eighth Grade Pupils." School Science and Mathematics, 71:1:69-74. January, 1971.

With eighth grade students, the pupil-inquiry teaching method produced a higher level of understanding of methods of science than did the teacher-directed method. There was no difference between methods in development of critical thinking ability and knowledge of science facts and principles.

Friot, Faith Elizabeth "The Relationship Between an Inquiry Teaching Approach and Intellectual Development." Unpublished doctoral dissertation. The University of Oklahoma. 1970. (Dissertation Abstracts 31:11:5872A. 1971. Order number 71-12,569).

It was found that changes in logical thinking processes among eighth and ninth graders could be evaluated by using Piagetan tasks. Some differences in the effectiveness of the Time, Space and Matter, Introductory Physical Science, and ESCP curricula were shown to exist at the different grade levels in developing logical thinking.

Glenn, William Harold "The Effectiveness of Learning in Earth Science Geology Units Through Field Trip Experiences: A Study of the Effects of Two Different Methods of Presenting Field Trip Experiences on Pupil Ability to Make Observations of and to Form Hypotheses Regarding Selected Geologic Features." Unpublished doctoral dissertation. New York University. 1968. (Dissertation Abstracts 30:1:206A. 1969. Order number 69-11,747).

See also: Glenn, William H. "Conceptual Ideas of Geology Included in Secondary School Earth Science Textbooks." Science Education, 54:1:27-30. January-March, 1970.

Three teaching procedures, field trip, in-class presentation using 35mm. slides, and a conventional earth science class control, were evaluated for effectiveness. The field trip produced no significant differences over the in-class slide presentation method.

Geer, Ira W. "A Follow-Up Study of the Effects of Service as Mesoscale Weather Observers." Journal of Research in Science Teaching, 5:4:350-354. December, 1968.

Public school students making observations for a mesoscale weather network were divided into two groups--actual weather observers and a control group of nonobservers. A follow-up study of the students' acquisition or retention of the basic knowledge of the atmospheric sciences, showed no significant differences between the observers and the control group.

Hassard, John Russell "An Investigation of Teacher and Student Behavior in Earth Science Classrooms." Unpublished doctoral dissertation. Ohio State University. 1969. (Dissertation Abstracts 30:10:4306-7A. 1970. Order number 70-6790).

A category system was developed for use in describing the classroom behavior of earth science teachers. A field test of the instrument found student and teacher behaviors to be correlated.

Kline, Arlyn A. "A Study of the Relationship Between Self-Directed and Teacher-Directed Eighth-Grade Students Involved in an Open-Ended ESCP Laboratory Block." Unpublished doctoral dissertation. University of Colorado. 1970. (Dissertation Abstracts 31:6:2756A. 1970. Order number 70-23,728).

See also: Kline, Arlyn A. "A Study of the Relationship Between Self-Directed and Teacher-Directed Eighth Grade Students Involved in an Open-Ended Supplementary ESCP Laboratory Block." Journal of Research in Science Teaching, 8:3:263-271.

Kline, Arlyn A. "Individualizing Instruction in Junior High Earth Science." The Science Teacher, 38:4:73-75. November, 1971.

Students are capable of a self-directed independent study employing the open-ended laboratory blocks. Most students indicated a strong interest in this type of learning.

Kline, Loren E. "Eighth-Grade Earth Science Textbook Readability and Other Factors Which Could Influence the Success of the Eighth-Grade Earth Science Course in the Texas Public Schools." Unpublished doctoral dissertation. East Texas State University. 1967. (Dissertation Abstracts 27:8:2283-4A. 1967. Order number 67-1529).

The reading difficulty of eighth-grade earth science textbooks was evaluated. None were found suitable for use in the Texas Public Schools. A questionnaire study of 491 teachers revealed that only 4.5% of the teachers met the minimal standards of academic preparation suggested by ESCP.

Ladd, George T. "Determining the Level of Inquiry in Teachers' Questions." Unpublished doctoral dissertation. Indiana University. 1969. (Dissertation Abstracts 31:1:247-8A. 1970. Order number 70-11,698).

See also: Ladd, George T. and Andersen, Hans O. "Determining the Level of Inquiry in Teacher's Questions." Journal of Research in Science Teaching, 7:4:395-400. 1970.

Andersen, Hans O. and Ladd, George T. "Questions and Earth Science Teaching: Using Your Influence Effectively." Journal of Geological Education, 19:5:236-238. November, 1971.

A study of the relationship of the level of inquiry in teacher questioning to group achievement in earth science classes resulted in an observation instrument which the classroom teacher can use to measure the level of inquiry of his questions.

Lauren, Paul M. "Teacher Behavior, Classroom Climate, and Achievement: An Investigation of Pupil Perception of Classroom Interaction and its Relationship to Achievement within Experimentally Controlled Environments." Unpublished doctoral dissertation. New York University. 1969. (Dissertation Abstracts 30:6:2420-1A. 1969. Order number 69-21,193).

Students are able to identify their achievement level. They not only prefer the more indirect method but learned earth science topics to a greater degree in the indirect classroom climate.

McDonald Dale E. "The Utilization of Planetaria and Observatories in Secondary Schools." Unpublished doctoral dissertation. University of Pittsburgh. 1966. (Dissertation Abstracts 27:12:I:4084A. 1967. Order number 67-7152).

Analysis of questionnaires completed by state education officials, school district officials, and authorities in astronomy and astronomy education demonstrated that the greatest

interest in developing astronomy curriculum programs and construction of planetariums and/or observatories was fostered by astronomy and astronomy education authorities. The local chief school administrators were found to be instrumental in initiating planetarium installation and the state education officials were found for the most part to be passive to the development.

McDonnell, K. S. "Graded Exercises in Geological Mapping." Center for Advancement of Teaching. Reprint Series Number 10 (Reprinted from the Australian Science Teachers Journal, 15:2. August, 1969).

This study is an evaluation of map exercises dealing with geological structures used in ascending order of difficulty. Results of their use with high school students indicated that the order of use of the map exercises was correct and that the use of the exercises increases the student's ability to understand and correctly interpret the main features of geological maps.

McNamara, Eugene S. "A Comparison of the Learning Behaviors of Eighth and Ninth Grade ESCP Earth Science Students: One-half Experiencing Laboratory Investigations in the Indoor Environment, The Other Half Experiencing Laboratory Investigations in the Outdoor Environment." Unpublished doctoral dissertation. Pennsylvania State University. 1971.

See also: McNamara, Eugene S., and Fowler, H. Seymour "The Reliability of the ESCP Achievement Test - Unit One." Journal of Geological Education, 19:4:182-183. September, 1971.

It was found, that learning in the out-of-doors is enhanced if the concepts being investigated are directly related to the students' environment. Critical thinking and attitudes toward the out-of-doors were changed favorably as a result of the out-of-doors treatment.

Richardson, Harold E. "A Color Motion Picture With Manual for Use in Physiography Classes in the Senior High School on the Subject Geysers and Geyser Action." Unpublished doctoral dissertation. New York University. 1949. (Dissertation Abstracts 9:2:72-74. 1949. Order number 1221).

A silent color motion picture film with teacher's manual was developed based on content of textbooks commonly used in New York State.

Rockcastle, Verne N. "Some Physical Factors of Microclimates and Their Use in Teaching Weather and Ecology." Unpublished doctoral dissertation. Cornell University. 1955. (Dissertation Abstracts 16:2:361-2. 1956. Order number 56-569).

The study of microclimates provided a direct-experience approach to the understanding of macroclimates.

Romey, William D. and Merrill, John H. "A Comparison of the Performance of Ninth-grade and College Students in Earth Science Laboratory Activity." The Science Teacher, 31:4:49-52. May, 1964.

The effectiveness of an experimental laboratory activity in teaching concepts of porosity, water retention, and permeability of sediments as related to artesian water systems was evaluated.

Sargent, Earl Alvin "A Study to Determine Certain Characteristics of Earth Science Curriculum Project Teachers and Students in the Permissive or Authoritarian Classrooms which lead to Greater Academic Achievement in These Students." Unpublished doctoral dissertation. Colorado State College. 1966. (Dissertation Abstracts 27:12:I:4451B. 1967. Order number 67-6084).

Students in the permissive classes showed an advanced achievement level especially if the teacher had a strong background of education courses.

Schirner, Silas Wesley "A Comparison of Student Outcomes in Various Earth Science Courses Taught by Seventeen Iowa Teachers." Unpublished doctoral dissertation. University of Iowa. 1967. (Dissertation Abstracts 28:8:3081-2A. 1968. Order number 68-974).

In a study of ninth grade earth science classes, it was found that students having traditional beliefs and a direct teacher performed better in the non-ESCP classes while students with non-traditional beliefs and indirect teachers did much better in the ESCP course. Overall, the factors influencing student outcomes were reinforced when compatible factors appeared in combination.

Sheppard, Kenneth E., Jr. "A Study of the Development of An Understanding of Science in Two Junior High School Science Courses." Unpublished doctoral dissertation. Oklahoma State University. 1970. (Dissertation Abstracts 31:8:3984A. 1971. Order number 70-21,477).

Students in ESCP classes being taught by an investigative approach achieved higher scores on tests of the understanding of the methods and aims of science, the scientific enterprise, and the scientist, than did the students in a traditionally taught general science course.

Smith, John P. "The Development of a Classroom Observation Instrument Relevant to the Earth Science Curriculum Project." Unpublished doctoral dissertation. Stanford University. 1969. (Dissertation Abstracts 30:8:3370A. 1970. Order number 70-1639).

See also: Smith, John P. "The Development of A Classroom Observation Instrument Relevant to the Earth Science Curriculum Project." Journal of Research in Science Teaching, 8:3:231-235. 1971.

A procedure and an instrument were developed for describing teaching performances under carefully specified conditions involving students, a teacher, and a new science curriculum (ESCP).

Spagnoli, Joe "Action Research With Programmed Materials." School Science and Mathematics, 65:2:155-158. February, 1965.

No differences in achievement were found between a seventh grade class using a linear programmed textbook and a class using conventional classroom materials.

Toohey, Jack Vincent "The Comparative Effects of Laboratory and Lecture Methods of Instruction in Earth Science and General Science Classes." Unpublished doctoral dissertation. Arizona State University. 1963. (Dissertation Abstracts 24:8:3241. 1964. Order number 64-2194).

See also: Toohey, Jack V., and Fullerton, B. J. "Earth Science Versus General Science in the Ninth Grade." Journal of Geological Education, 12:3:102-103. September, 1964.

Ninth grade earth science and general science courses were compared as well as lecture and laboratory teaching methods. It was concluded that the earth science course was superior in developing science subject matter achievement and science material reading ability and comprehension. The laboratory method was superior in retention of subject matter.

Weisberg, Joseph S. "The Use of Visual Advance Organizers for Learning Earth Science Concepts." Unpublished doctoral dissertation. Teachers College, Columbia University. 1969. (Dissertation Abstracts 30:9:3867-8A. 1970. Order number 70-4525).

See also: Weisberg, Joseph S. "The Use of Visual Advance Organizers for Learning Earth Science Concepts." Journal of Research in Science Teaching, 7:2:161-165. 1970.

Eighth graders studying the Theory of Continental Drift were exposed to different organizers followed by a new learning task. Visual advance organizers functioned at a significant level whereas expository advance organizers did not.

Wright, Delivee Loraine Cramer "Effectiveness of the Planetarium and Different Methods of Its Utilization in Teaching Astronomy." Unpublished doctoral dissertation. University of Nebraska. 1968. (Dissertation Abstracts 30:2:507A. 1969. Order number 69-9660).

No significant differences in achievement were found between 8th grade students who had preparation and follow-up activities with the planetarium program and those with just the planetarium program. Students not attending the planetarium program achieved less than those attending.

Student characteristics

The last group of six studies is quite diverse, but generally they concern the nature of the student in the secondary school and the relation of specific student characteristics to achievement.

Bicak, Laddie J. "Achievement in Eighth Grade Science by Heterogeneous and Homogeneous Classes." Unpublished doctoral dissertation. University of Minnesota. 1962. (Dissertation Abstracts 23:7:2367-8. 1963. Order number 63-1192).

See also: Bicak, Laddie J. "Achievement in Eighth Grade Science by Heterogeneous and Homogeneous Classes." Science Education, 48:1:13-22. February, 1964.

Ability grouped classes taught meteorology under controlled conditions achieved at the same mean level as heterogenous classes.

Connors, Robert E. "Geographic Problem Solving Behavior of Eighth Grade Students in the Warren Beaty Junior High School." Unpublished doctoral dissertation. Pennsylvania State University. 1959. (Dissertation Abstracts 20:8:3221. 1960. Order number 59-6769).

A high correlation existed between problem solving ability and physical geographic concept achievement, when verbal responses and abstractions were involved, and low correlations when concrete situations were involved.

Dennis, Ronald T. "A Comparative Study of the Performances of Sixth Grade Graduates and Selected Adults on a Science Test Concerning Outer Space." Unpublished doctoral dissertation. University of Alabama. 1962. (Dissertation Abstracts 23:11:4163-4. 1963. Order number 63-2046).

Satisfactory test performances were reported for both groups, with one-eighth of the student group scoring above the average adult score. Boys scored significantly higher than did the girls. Differences in performance between adult subgroups were also reported.

Meder, Elsa M. "Youth Considers the Heavens; High School Students' Opinions About Man's Place in the World in Relation to Their Astronomical Information." Unpublished doctoral dissertation. Teachers College, Columbia University. 1942.

See also: Meder, Elsa M., and Boenig, Robert W. "Youth Considers the Heavens." Research in Science Education 1938 through 1947. Teachers College Press, Columbia University. 1969. pp. 154-158.

This study related change of opinion about man's place in the world with changes in knowledge about the extent of the universe.

Sorenson, Juanita Sumpter "A Comparison of Responses on Three Types of Instruments in Measuring Secondary School Pupil Attitudes Toward Space Exploration." Unpublished doctoral dissertation. The University of Wisconsin. 1971. (Dissertation Abstracts 32:6:2925-6A. 1971. Order number 71-23,329).

Attitudes were found to be positive. Significant positive correlations were found between attitude and; 1) general grade point average, 2) science grade point average, 3) total number of science credits earned in high school, and 4) grade in chemistry.

Troost, Cornelius "A Study of Socioeconomically Divergent Superior Students in an Aerospace Enrichment Program." Science Education, 53:4:325-328. October, 1969.

A comparison of the effects of a summer program on two groups of talented junior high school science students; underprivileged central city students and middle to wealthy class students indicated that high achieving students from completely disparate socioeconomic backgrounds did not differ significantly in general science achievement.

EARTH SCIENCE IN THE COLLEGES

Those studies focusing primarily on the college level fell into four groups. One included studies concerned with preservice or inservice teacher preparation in earth science. Other groups included: studies concerned with methods and techniques of instruction, studies concerned with student characteristics and studies focusing on the content of science courses and programs for training science majors.

Earth science teacher preparation

The twelve studies in this group were quite diverse in their objectives. Some determined programs for the preservice preparation of earth science teachers, others were concerned with the design and evaluation of inservice education programs. A few dealt with specific techniques to be used in the preparation of earth science teachers.

Bartholomew, Roland B. "A Study to Determine the Effect of Earth Science Instructional Models on the Investigative Teaching Behaviors of Experienced Science Teachers." Unpublished doctoral dissertation. University of Maryland. 1970. (Dissertation Abstracts 31:11:5894A. 1971. Order number 71-13,175).

Videotaping and scoring of prelab and postlab discussions with a modified Flanders Interaction Analysis indicated that the use of instructional models produced changes in the investigative teaching behavior of experienced teachers toward the model they studied.

Branley, Franklin "Astronomy for the Elementary School Teacher." Unpublished doctoral dissertation. Teachers College, Columbia University. 1957.

An in-service course in astronomy was developed for use in the Hayden Planetarium (New York). The basic concepts identified were: change is continuous in the universe, motion is universal, the universe is extremely large, and man obtains knowledge through his senses.

Charlier, Roger H. and Charlier, Patricia S. "Geographic and Environmental Illiteracy Among Educated Americans--an Appraisal." Science Education, 54:3:281-286. July-September, 1970.

Study of college earth science and geography course offerings and the certification requirements for geography teachers in the United States indicated a lack of geography content in earth science curricula and a lack of geography programs. There is a great need for better teacher education programs in geography.

Flores, Jose A. "A Study of Earth Science Programs in Texas and at the National Level." Science Education, 54:4:379-383. October-December, 1970.

A survey of former earth science institute participants at three universities indicated that they felt that the institutes helped them, that money shortages prevented them from upgrading their earth science curriculum, and that they preferred to teach earth science rather than general science.

Jackson, Jim L. "An Assessment of an In-service Program in Earth Science for Producing Changes in Teacher Behavior and Pupil Achievement." Unpublished doctoral dissertation. The Ohio State University. 1970. (Dissertation Abstracts 31:10:5249A. 1971. Order number 71-7486).

Significant changes occurred in use of inquiry methodology by teachers and in pupil achievement.

Mayer, Victor James "A Study of Existing Pre-Service Earth Science Teacher Preparation Programs." Unpublished doctoral dissertation. University of Colorado. 1966. (Dissertation Abstracts 28:3:989A. 1967. Order number 67-9998).

See also: Mayer, Victor J. "Criterion Model of an Earth Science Teacher Preparation Program." Science Education, 51:3:290-292. 1967.

Mayer, Victor J. "Science Requirements in Earth Science Teacher Preparation Programs." Journal of Research in Science Teaching, 5:3:276-281. 1967.

A questionnaire study of teacher training institutions found that 123 schools presently had and 62 were planning earth science teacher preparation programs. In-depth case studies of five of the programs were developed. Major conclusions were: 1) states with secondary school earth science programs have more earth science teacher preparation programs, 2) program requirements vary, 3) many programs are geology majors plus some other earth science courses, and 4) little is done in investigative and student centered instruction techniques.

Passero, Richard N. "Master's Degree Programs for the Preparation of Secondary Earth Science Teachers." Unpublished doctoral dissertation. Indiana University. 1970. (Dissertation Abstracts 31:7:3300A. 1971. Order number 70-26,945).

See also: Passero, Richard N. "NSF Earth Science Institutes." Geotimes, 16:7:12-16. July, 1971.

This study used questionnaires and interviews with college personnel as sources of information about Master's programs. Studied were enrollment in programs, courses offered and characteristics of teachers not having Master's degrees.

Sanders, Leroy John "Aerospace Education for Teachers Based on Recommendations of Selected Aviation and Space Industries." Unpublished doctoral dissertation. Colorado State College. 1967. (Dissertation Abstracts 28:7:2587-8A. 1968. Order number 68-456).

Planned industrial tours by teachers, meetings between representatives of industry and education, and directed field study of industries by teachers were highly favored by member companies of the Aerospace Industries Association of America for providing elementary and secondary school teachers with knowledge of aerospace science. Less than fifty per cent of the companies wrote articles for school journals. Thirty per cent of the companies had materials of value and interest to teachers.

Shrum, John Wesley "A Proposed Curriculum for the Preparation of Earth-Science Teachers." Unpublished doctoral dissertation. The Ohio State University. 1963. (Dissertation Abstracts 24:11:4576. 1964. Order number 64-7054).

This study included: 1) a survey of periodical literature about the adequency of earth science teacher education, 2) a study of state certification requirements, and 3) an analysis of summer institute directors' reports concerning experiences needed by earth science teachers. A recommended program for earth science teacher preparation was based on the resulting information.

Sonnier, Isadore L. "A Study of the Number of Selected Ideas in Astronomy Found in Earth Science Curriculum Project Materials being Taught in College and University Astronomy Courses." Unpublished doctoral dissertation. Colorado State College. 1966. (Dissertation Abstracts 27:8:2433-4A. 1967. Order number 67-1134).

Results suggested that the college astronomy courses taken by prospective earth science teachers provided sufficient subject matter background in astronomy.

Sutherland, Berry "An Evaluation of Two National Science Foundation Academic Year Institutes for Earth Science Teachers." Unpublished doctoral dissertation. University of Houston. 1970. (Dissertation Abstracts 32:1:291-2A. 1971. Order number 71-17,860).

The validity of a theoretical evaluation model to measure changes in earth science content knowledge affected by the NSF programs was tested.

Zurhellen, Joan H. "An Evaluation of Attitude Changes Among Science Teachers During an ESCP In-Service Institute." Unpublished doctoral dissertation. University of Tennessee. 1970. (Dissertation Abstracts 31:9:4613-4A. Order number 71-7699).

Shifts in teacher attitudes occurred. Recommendations were made that several short-term, highly concentrated in-service sessions be utilized rather than long-term in-service programs.

Methods of teaching science content

A large number of studies (22) were concerned with the methods and techniques appropriate for teaching earth science content at the college level. A typical study compared the effectiveness of one teaching method or technique with another, usually in terms of student gains in achievement or interest in science.

Baldwin, Brewster "The Creative Curriculum." Journal of Geological Education, 18:2:91-93. March, 1970.

Representatives of thirty-five undergraduate geology departments responding to questionnaires favored undergraduate student research although only a few indicated that their departments had a definite undergraduate research program.

Brovey, Daniel James "The Effectiveness of Advance Organizers in Acquiring Geological Knowledge in the Field." Unpublished doctoral dissertation. Columbia University. 1969. (Dissertation Abstracts 30:9:3814A. 1970. Order number 70-4506).

The effects of advance organizers and historical introductions are compared. Neither type of introduction was superior in the acquisition or retention of geological knowledge.

Bybee, Rodger W. "The Effectiveness of an Individualized Approach to a General Education Earth Science Laboratory." Science Education, 54:2:157-161. April-June, 1970.

Students in the control group had lecture-demonstration classes. No significant achievement differences between the groups was demonstrated, although the experimental group showed more interest in science.

Carlson, Roger L. "A Comparison Between the Teaching Effectiveness of a Large-Group Lecture and a Large-Group Discussion When Evaluating the Cognitive and Affective Domains." Unpublished doctoral dissertation. Colorado State College. 1970. (Dissertation Abstracts 31:4:1642-3A. 1970. Order number 70-18,330).

Teaching college students in a large-group lecture section was more effective in achieving understanding of earth science content at the comprehension, synthesis, application, analysis, evaluation, and knowledge levels. No significant changes occurred in student's attitudes towards science as a result of either method.

Deluca, Frederick "The Development and Implementation of Structured Inquiry Methods and Materials for an Introductory Geology Laboratory Course and Their Effectiveness as Compared With The Traditional Course." Unpublished doctoral dissertation. The University of Oklahoma. 1970. (Dissertation Abstracts 31:11:5870-1A. 1971. Order number 71-12,564).

This study found a positive attitude toward the experimental college level laboratory course and increased positive attitudes, toward geology and science in the students. The content achievement was no different between the experimentally or traditionally taught groups of students.

Follette, Everett L. "An Appraisal of Change of Attitudes Toward Science and Scientists by Students Who Have Participated in an Intrinsically Motivated Earth Science Class." Unpublished doctoral dissertation. University of Colorado. 1971.

Students participating in a college level class expressed interest in taking additional coursework presented in the intrinsically motivated format. It had no effect on attitudes toward science.

Geer, Ira W. "An Experimental Study Comparing Two Approaches to the Teaching of a Selected Introductory Meteorology Course for Prospective Teachers." Unpublished doctoral dissertation. Pennsylvania State University. 1966. (Dissertation Abstracts 27:9:2915A. 1967. Order number 67-1925).

Both the local weather approach and the weather map approach were found effective in teaching the basic facts, principles, and concepts of meteorology. Higher ability students achieved higher interpretive ability in the weather map approach and lower ability students achieved greater interpretive ability if taught by the local weather method. Both methods were equally good in preparing teachers and thus it was recommended that the instructor use the method he personally prefers.

Hoff, Darrel B. "A Comparison of a Directed Laboratory Versus An Enquiry Laboratory Versus a NonLaboratory Approach to General Education College Astronomy." Unpublished doctoral dissertation. The University of Iowa. 1970. (Dissertation Abstracts 31:6:2755A. 1970. Order number 70-23,898).

This study found no significant differences between groups taught by the three methods on achievement and retention of concepts and facts. The inquiry group gained most in critical thinking, in subject preference, and on a test of transfer.

Loar, Dorothy M. C. "An Experimental Study of Programmed Instruction in A College Physical Geography Course." Unpublished doctoral dissertation. Fordham University. 1965. (Dissertation Abstracts 26:7:3770. 1966. Order number 65-14,148).

Three instructional procedures for presenting a unit on meteorology were compared; use of programmed text for independent study, use of programmed text and a conventional textbook, and use of textbook only.

Maccini, John Andrew "Evaluation of an Audio-Visual Tutorial Laboratory Serving College-Level Introductory Geology." Unpublished doctoral dissertation. The Ohio State University. 1969. (Dissertation Abstracts 30:7:2872-3A. 1970. Order number 69-22,171).

The audio-visual tutorial program developed at The Ohio State University was evaluated to provide information for curriculum improvement and program revision. Significant increases in student achievement were indicated, and 81% of students had a favorable attitude toward the AVT program.

MacMahan, Horace Arthur, Jr. "Development and Evaluation of an Overhead Transparency Series for Use in Teaching Topographic and Geologic Map Concepts to Physical and Historical Geology Classes." Unpublished doctoral dissertation. University of Colorado. 1967. (Dissertation Abstracts 29:2:413A. 1968. Order number 68-10,642).

The use of transparencies developed as an aid in teaching geology classes was compared to the conventional manner of teaching. Students learned the basics of topographic and geologic mapping without the use of overhead projector transparencies, although they preferred their use.

McClurg, James E. "The Development and Experimental Evaluation of An Open-Scheduled Auto-Tutorial Geology Laboratory." Unpublished doctoral dissertation. University of Michigan. 1971. (Dissertation Abstracts 32:3:1358A. 1971. Order number 71-23,823).

The effectiveness of an open-scheduled auto-tutorial laboratory was compared to that of a standard laboratory course in terms of achievement, attitude and attendance.

Parsons, Bula Gail "The Comparative Effects of Overlays on Student Acquisition of Earth Science Concepts." Unpublished doctoral dissertation. University of Utah. 1969. (Dissertation Abstracts 30:9:3645-6A. 1970. Order number 70-2808).

The effectiveness of using an overlay study board with a physical geography class was evaluated. Mean scores were higher but not statistically significant for the experimental group on all variables tested. The use of the overlays significantly increased the students appraisal of their own understanding of the physical geography concepts involved.

Reed, George F. "A Comparison of the Effectiveness of the Planetarium and the Classroom Chalkboard and Celestial Globe in the Teaching of Specific Astronomical Concepts." Unpublished doctoral dissertation. University of Pennsylvania. 1970. (Dissertation Abstracts 31:9:4580A. 1971. Order number 71-6721).

See also: Reed, George F. "Is the Planetarium a More Effective Teaching Device than the Combination of the Classroom Chalkboard and Celestial Globe?" School Science and Mathematics, 70:6:487-492. June, 1970.

The chalkboard celestial globe teaching method was more effective than planetarium presentations in producing immediate cognitive changes with college students. Neither method was superior in producing affective changes.

Shaver, Paul Merl "A Study of the Effectiveness of an Independent Study Program for a Beginning Course in Earth Science." Unpublished doctoral dissertation. Syracuse University. 1969. (Dissertation Abstracts 31:1:310A. 1970. Order number 70-12,805).

A group of college earth science students instructed in an independent study program was compared with a group instructed by the traditional lecture-discussion-laboratory presentation. No differences in learning occurred. The independent study program did allow the instructor to work with 1.28 times the normal student load.

Siemankowski, Francis T. and Cazeau, Charles J. "Auto-Paced Laboratories in Physical Geology." Journal of Geological Education, 17:2:38-42. April, 1969.

Auto-paced laboratories using tape recorded instruction and questioning, film loops, filmstrips, and other prepared laboratory materials for individual student use were compared with the conventional graduate-assistant-taught laboratory. Auto-paced laboratories produced superior student achievement.

Smith, F. G. "A Hybrid Man-Machine Teaching Method." Journal of Geological Education, 14:4:123-126. October, 1966.

A study of the use of computer programs in selecting objective examination statements, scoring student responses, and analyzing results indicated their effectiveness and practicality for use in teaching college-level elementary geology.

Stevenson, Robert L. "The Effects of a Supplementary Programmed Textbook on Transfer of Training to Particular Geologic Interpretations: An Experimental Study." Unpublished doctoral dissertation. Southern Illinois University. 1969. (Dissertation Abstracts 30:10:4665B. 1970. Order number 70-7318).

A supplementary programmed textbook used by college earth science students resulted in no differences in the achievement levels, in transfer of training, in student success in applying the skills learned, and in acquiring knowledge.

Strope, Marvin B. "A Comparison of Factual and Conceptual Teaching in Introductory College Astronomy." Unpublished doctoral dissertation. Utah State University. 1966. (Dissertation Abstracts 27:8:2457-8A. 1967. Order number 66-13,869).

See also: Strope, Marvin B. and Braswell, A. L. "A Comparison of Factual Teaching and Conceptual Teaching in Introductory College Astronomy." Journal of Research in Science Teaching, 4:2:95-96. 1966.

Conceptual teaching may promote greater interest in taking further science coursework.

Tanner, William "The 'Scrambled Book' In Freshman Geology." Journal of Geological Education, 15:2:69-73. April, 1967.

The use of "scrambled book" assignments was compared with lecture in freshman geology classes. The scrambled book, a type of programmed learning workbook, was given only to students who did not attend lectures. There were no differences on test scores and average grades between the two groups. Students did not like the scrambled book method.

Utgard, Russell O. "Verbal Behavior of Recitation Teachers and Achievement of College Geology Students." Unpublished doctoral dissertation. Indiana University. 1969. (Dissertation Abstracts 30:10:4294-5A. 1970. Order number 70-7998).

Student achievement was not significantly affected by the type of verbal behavior, whether direct or indirect, used by the graduate student recitation teacher.

Waechter, Richard Fredrick "A Comparison of Achievement and Retention by College Junior Students in an Earth Science Course After Learning Under Massed and Space Conditions." Unpublished doctoral dissertation. Pennsylvania State University. 1966. (Dissertation Abstracts 27:11:3642-3A. 1967. Order number 67-5980).

This investigation compared the effect of massed learning to spaced learning upon the acquisition and retention of science facts by elementary education students. Neither method of instruction was superior for student retention of science facts.

Refer also to the following study:

Romey p. 24

Student characteristics

Six studies focused on students and the determination of factors relating to their performance in college science courses.

Burford, Ernest, Jr. "The Reading Abilities of College Freshmen Earth Science Students Compared with the Readability of Selected Earth Science Textbooks." Unpublished doctoral dissertation. East Texas State University. 1969. (Dissertation Abstracts 30:12:I:5315-6A. 1970. Order number 70-11,281).

The readability of the majority of the earth science textbooks was rated at the twelfth and thirteenth to fifteenth grade levels. It was found that 38% of the students were reading below these levels.

Henderson, Arnold R. "Factors Relating to Success of Students in Physical Geology in Higher Education." Unpublished doctoral dissertation. Mississippi State University. 1970. (Dissertation Abstracts 31:10:5148-9A. 1971. Order number 71-8823).

Achievement in physical geology was predicted on the basis of records. Predicted grades were not significantly different from the grades assigned by the instructor.

McKinnon, Joe W. "Earth Science, Density, and The College Freshman." Journal of Geological Education, 19:5:218-220. November, 1971.

A study of concepts of density held by college freshmen found that more than one-third of the students were unable to relate volume and weight in any meaningful way.

Muehlberger, William R. and Boyer, Robert E. "Space Relations Test as a Measure of Visualization Ability." Journal of Geological Education, 9:2:62-69. Fall, 1961.

See also: Boyer, Robert E., and Muehlberger, William R. "Significance of a Culture Test Given to Geology Graduate Students." Journal of Geological Education, 11:2:69-73. 1963.

The Space Relations Test was given to geology and petroleum engineering majors at the University of Texas at the beginning of the structural geology course. A positive correlation occurred between performance on the test and final grades in structural geology and prerequisite geology courses.

Paul, Richard A., Larson, A. C., and VandenAvond, Richard "Predicting the Effect of ESCP on Introductory College Geology Courses." Journal of Geological Education, 17:2:47-53. April, 1969.

This study evaluated the effects of secondary school earth science upon performance in introductory college geology courses. Results of the study suggest that ESCP is an effective program for scientific understanding.

Ralya, L. L. "Some Significant Concepts and Beliefs in Astronomy and Geology of Entering Freshmen and the Relation of These to General Scholastic Aptitute." School Science and Mathematics, 40:8:727-734. November, 1940.

Freedom from misconceptions was found to be positively correlated with scholastic aptitude.

Science course and program content

Fourteen studies dealt in some respect with the nature of major programs in science or the content of college science courses. Most were status studies using survey techniques in the collection of data.

Baker, Glenn S. "Space Science: A Monograph for a Course in a General Education Program." Unpublished doctoral dissertation. Teachers College, Columbia University. 1968. (Dissertation Abstracts 29:10:3313-4A. 1969. Order number 69-6023).

A monograph was developed for use in an introductory college-level space science course. A panel of experts from the various scientific disciplines, NASA, and the field of Science Education aided in the final selection of topics.

Claridge, Geoffrey G. "A Study of the Events and Trends in Programs for the Preparation of Astronomers in the United States 1947-1960." Unpublished doctoral dissertation. University of Wisconsin. 1963. (Dissertation Abstracts 24:6:2218-9. 1963. Order number 64-558).

A questionnaire survey of institutions training astronomers was used to identify trends in their academic preparation. Little concern for preparing elementary and secondary school teachers was expressed by survey respondents. Recommendations for the preparation of astronomers were made.

Hendrix, Thomas E., and Fox, William T. "Experimental Approaches to the Introductory Geology Course." Journal of Geological Education, 13:5:137-142. December, 1965.

The results of a ten-school survey of introductory college geology courses were reported including a description of course offerings.

Hendrix, Thomas E. "NAGT Looks at Summer Field Courses." Journal of Geological Education, 15:2:73-77. April, 1967.

A questionnaire survey of all geo-science degree granting departments in the United States and Canada revealed that 81% of all summer field courses operated from fixed sites and that most operated from 4 to 8 weeks and offered 4 to 8 semester hours credit. Over half of the departments required a summer field course for graduation; where not required, students did not take summer field courses. The field course quality was evaluated on the basis of teacher-student ratio, teacher experience, facilities, field exercises, and student achievement. Many respondents considered a field course to be the most important course for a geology undergraduate.

Ivey, Marvin Lee "Geology for Florida Junior Colleges." Unpublished doctoral dissertation. University of Florida. 1961. (Dissertation Abstracts 22:1:183-184. 1961. Order number 61-2235).

This study produced criteria for development of a course and tested these criteria by designing a geology course for junior college programs in Florida.

Kramer, Max "Mathematics in Meteorology, With Suggestions for Teachers of Mathematics and Meteorology." Unpublished doctoral dissertation. Columbia University. 1949. (Dissertation Abstracts 10:3:70-72. 1950. Order number 1722).

The history of meteorological education and the mathematical training of meteorologists were reported. Recommendations for the preparation of meteorology teachers and source materials for meteorology curriculum development were made.

Leyden, Michael B. "A Laboratory Oriented College Course in Environmental Geology." Unpublished doctoral dissertation. University of Florida. 1970. (Dissertation Abstracts 32:1:269A. 1971. Order number 71-17,183).

An introductory environmental geology course was designed which emphasized the sociological and laboratory implications of the study of geology. Five conceptual themes were interwoven into a curriculum guide, behavioral objectives were written, and suitable laboratory activities were designed to assist the student in achieving the selected environmental geology concepts.

Nutter, Neill H. "The Compilation and Evaluation of Instructional Objectives for Introductory Geology Courses Taught by the Audio-Tutorial Approach at Institutions of Higher Learning in The United States." Unpublished doctoral dissertation. Michigan State University. 1971. (Dissertation Abstracts 32:3:1263A. Order number 71-23,223).

Course objectives were evaluated against Mager's definition of behavioral objectives.

Paul, Richard A. "Analysis of Some Aspects of Geology Summer Field Courses." Journal of Geological Education, 17:1:17-23. April, 1969.

A survey of geology departments yielded data on geology summer field courses offered during the summer of 1967. Student enrollments, field course budgets, course offerings, and faculty/student ratios were summarized as a basis for providing guidelines for future geology summer field courses.

Reeves, Robert G. and Delo, David M. "Requirements in the Field of Geology." CEGS Programs Publication #5, American Geological Institute, Washington, D.C. April, 1970.

Responses to questionnaires, designed to obtain data for design and revision of undergraduate earth science curricula, reflected the opinions on the effectiveness and relevance of the respondents' education to their practice of geology. The

results indicated that only 24% of the areas considered basic in a geologist's education and practice were found useful or vital to 50% of the respondents. Only 5% of the areas were useful to 75% of the 1105 respondents.

Rhodes, F. H. T. "Undergraduate Geology: A Strategy for Design of Curricula." American Geological Institute, Washington, D.C. 1971.

The present status of geological education including earth science teacher preparation programs and undergraduate geology programs was reported. A comprehensive bibliography of the literature of undergraduate geology curriculum development was included.

Roth, Eldon S. "Geology in the Junior College." Unpublished doctoral dissertation. University of Southern California, Los Angeles. 1969. (Dissertation Abstracts 30:2:501A. 1969. Order number 69-13,076).

See also: Roth, Eldon S. "Junior Colleges." Geotimes, 14:4:17-18. April, 1969.

A survey indicated that the most common geology courses offered were physical geology, historical geology, survey of geology, and mineralogy. Other findings concerning geology offerings were reported.

Tomikel, John "American Geological Education: 1954-1969." Unpublished doctoral dissertation. University of Pittsburgh. 1970. (Dissertation Abstracts 31:5:2135A. 1970. Order number 70-20,331).

Changes were reported in geological education degree requirements, student enrollments in geology and the role of geological organizations and journals during the period 1954-1969.

Wittmer, Paul W. "The Secularization of Geology Textbooks in the United States in The Nineteenth Century." Unpublished doctoral dissertation. New York University. 1967. (Dissertation Abstracts 28:11:4464-5A. 1968. Order number 68-6174).

This study traced the gradual change in the point of view of geology textbooks from religious fundamentalism to secularism and related this change to scientific progress.

Refer also to the following studies:

Baker p. 11 Dolezal p. 15

QUALIFICATIONS OF EARTH SCIENCE TEACHERS

Of five studies, one examined certification requirements, while the others focused specifically on the science content background of earth science teachers. The status of the then current preparation of teachers to teach earth science was established with recommendations for improving teacher competence.

Boyer, Robert E., and Snyder, John L. "Teachers of Earth Science." Geotimes, 9:3:13-16. March, 1964.

Applications of 1,253 science teachers to NSF Summer and Academic Year Institutes at three universities were examined. Academic backgrounds of earth science teachers were found to be deficient.

Boyer, Robert E., and Snyder, John L. "Earth Science Gains Momentum in the Secondary Schools." Journal of Research in Science Teaching, 4:1:43-44. March, 1966.

Despite an increase in the number of earth science classes being taught, teacher preparation had not changed correspondingly. A survey of 2,145 applications to earth science program academic year institutes confirmed the need for additional training.

Moss, John E. "The Teacher Problem in High School Earth-Science Courses." Journal of Geological Education, 10:2:41-44. June, 1962.

Most applicants for several NSF-supported earth science summer institutes had little academic background in the earth sciences.

Shea, James H. "Highlights of 1965 ESCP Survey of Earth Science Teachers." Journal of Geological Education, 14:1:9-12. February, 1966.

A questionnaire survey of earth science teachers indicated a lack of adequate teacher preparation. Student laboratory work was utilized by sixty percent of the teachers and field trips and/or field work by forty percent.

Qutub, Musa Y., and Roy, Chalmer "The Status of States' Certificates of Earth Science Teachers." Journal of Geological Education, 19:3:147-148. May, 1971.

Results of a survey of state departments of education identified several general patterns for the certification of earth science teachers and provided data on certification requirements for each state.

MUSEUMS AND PLANETARIUMS

One study examined museums as public educational institutions. Two studies were concerned with planetariums; one with their administration and one with the programs offered.

Bergen, Catharine "Physical Science Museums." Science Education, 53:3:197-202. April, 1969.

A number of science museums were studied. The percentage of the exhibits devoted to the earth sciences ranged from 10-48%. The exhibits which involved the visitor in some type of manipulation received the greatest visitor response and retained attention much longer than did static exhibits.

Chamberlain, Joseph M. "The Administration of a Planetarium As an Educational Institution." Unpublished doctoral dissertation. Columbia University. 1962. (Dissertation Abstracts 23:11:4180. 1963. Order number 63-3,754).

This historical study traced the development of planetarium installations in educational institutions. Also discussed were types of projectors in use, uses of a planetarium and suggested guidelines for planetarium operation.

Curtin, John T. "An Analysis of Planetarium Program Content and The Classification of Demonstrators' Questions." Unpublished doctoral dissertation. Wayne State University. 1967. (Dissertation Abstracts 29:1:56A. 1968. Order number 68-9954).

This study investigated the astronomy content of planetarium programs presented to school groups. The cognitive level of questions asked by planetarium directors was determined and administrative practices of the directors were studied.